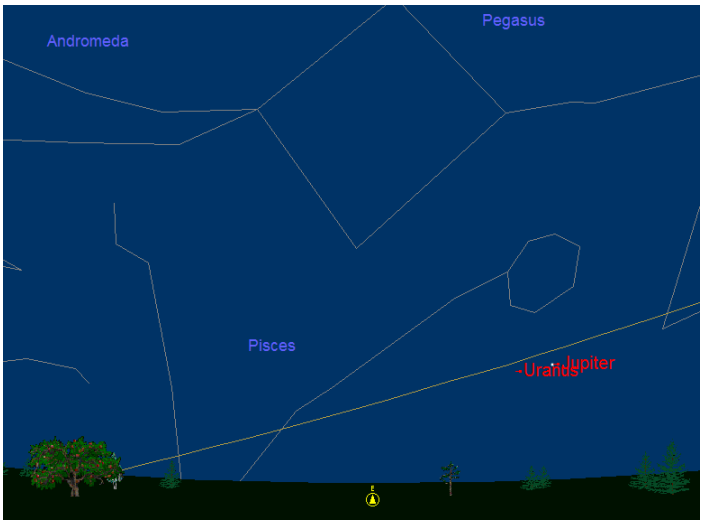
NEWBURY ASTRONOMICAL SOCIETY
BEGINNERS SECTION MAGAZINE – MAY 2010

JUPITER BACK IN VIEW



Jupiter is just starting to emerge from behind the Sun where it has been out of view for the past few months. The king of the planets was last seen low in western sky in January as it moved into conjunction with the Sun (passed behind).

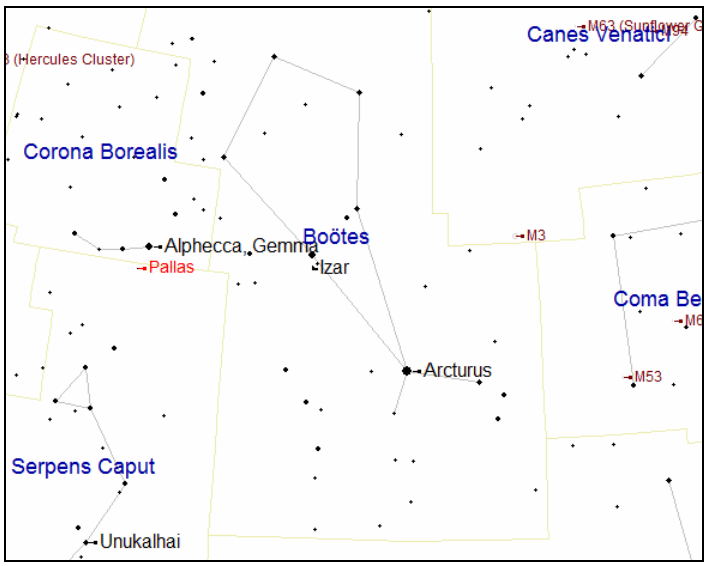
For those who like to rise early in the morning Jupiter is theirs to see. The chart above shows the location of Jupiter in the constellation of Pisces at 04:30 during mid May. Jupiter actually climbs over the eastern horizon at 03:30 which is 1½ hours before the Sun. However the sky will be brightening as Jupiter first appears. At locations with a clear view towards the east Jupiter should be visible by 04:00. Being so low in the sky any detail on the planet will be difficult to discern. The four largest moons may just be visible before the sky gets to light.

Jupiter and the four brightest moons

The picture above shows how Jupiter appears in more favourable seeing conditions. The seeing conditions are much more challenging at the moment but will improve later in the year as the giant planet climbs higher in the sky and rises at a much more civilised hour.

Jupiter is a great target for a modest sized telescope. It is large, bright and is never the same from on night to the next. The moons appear in different positions as they move around their orbits and sometimes pass in front of the planet and cast a shadow on the surface. The cloud patterns also change continuously as the planet rotates on its axis every 10 hours.

THE CONSTELLATION OF BOÖTES



Boötes is a fairly large constellation located to the east of Leo and Coma Berenices and to the west of Hercules and Corona Borealis. All but one of the stars in Boötes are fairly faint but Arcturus the only bright star does make up for the rest.

Arcturus is a bright red giant star and is by far the brightest star in this region of the sky. With a magnitude of -0.04 it is the forth brightest star in our night sky. It is an old star that has nearly exhausted its Hydrogen fuel supply and has begun the process of dying (figuratively speaking). It started its life as a bright white star with a mass 25 times greater than our Sun. Being so large it consumed its fuel supply veraciously and soon began to run out of Hydrogen.

Unlike our Sun, Arcturus is massive enough to use the Helium that it had created in its core as additional fuel to keep the nuclear fusion process going. Fusing the Helium comes at a price as the extra energy produced has caused the star to expand. As the area of the outer surface expanded the heat produced was spread over an ever larger area and the surface became cooler until it is now about 3900°C (our Sun is 6400°C). As the surface cooled the colour of the star first changed from white to yellow and then to orange as we see it now. As Arcturus grows even larger over the next few million years it will appear to become redder in colour as the surface continues to become cooler.

Our Sun is located in the main flat spiral disc structure in our galaxy that we call the Milky Way. The Sun is in fact on the edge of one of the spiral arms of the Milky Way. Arcturus is not in the disc structure but is located in what is known as the galactic halo. This is a halo comprised of mainly older stars located above and below the main spiral disc structure.

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19th May Radio Telescopes

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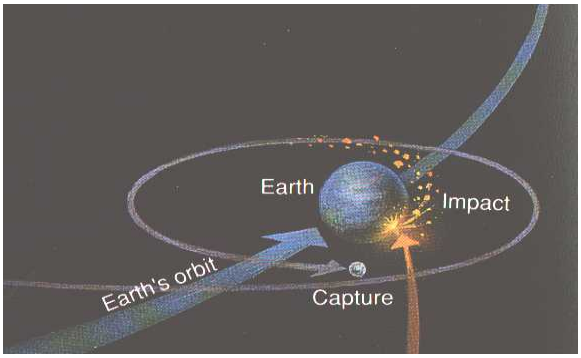
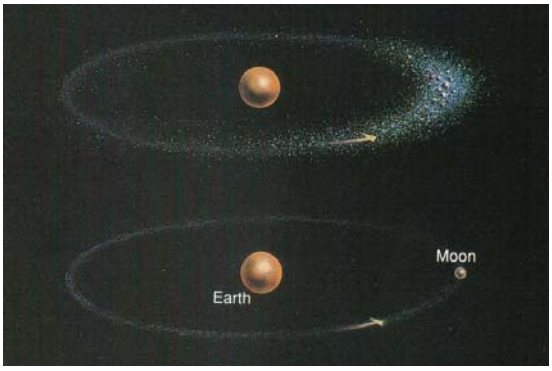
THE MOON OUR CONSTANT COMPANION

By far our closest neighbour is the Moon. It is a mere 384,000 kilometres away and is the only celestial object that we can see with the naked eye that has surface markings. We may ask what is the Moon, how did it come to be in orbit around Earth and how was it created? Evidence suggests that in the early solar system there were many more planets than the nine we see today. There certainly were more than 30 and possibly as many as 100 when the Solar System formed. Many of these fledgling planets had erratic orbits making close encounters and collisions likely. Close encounters could throw planets out of their orbits and send them hurtling out into space or crashing into the Sun. It is now thought that Earth suffered a collision with another planet about the size of Mars very soon after they had formed.



The off centre impact with Earth threw a huge mass of molten rock up into space and into orbit around Earth. The other planet was totally destroyed. Eventually this debris cooled and reformed into the Earth and Moon we see today.

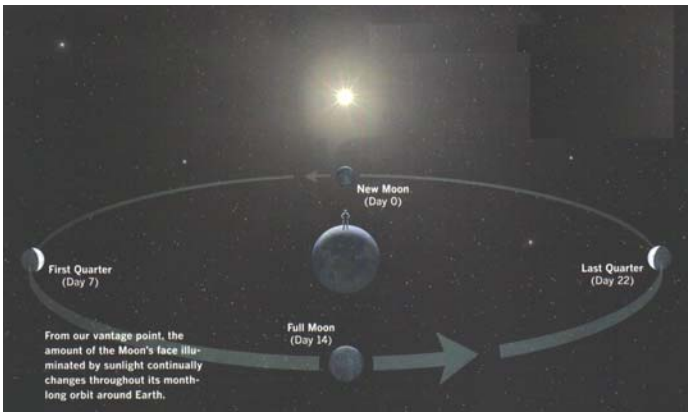


Our Moon is very important to the day to day life on Earth and is historically very important to mankind. The most noticeable effect on Earth is the way it raises the tides in our oceans. Some scientists think that life on Earth may even have started in the margins between high and low tide. In the beginning of this Earth / Moon relationship, the Moon was much closer than it is today and would have appeared ten times larger in the sky. It is still moving away from Earth by 3.8 centimetres every year but will remain our constant companion for billions of years to come. The importance of the Moon to humans is still with us today in the way we divide our year into months. A month is derived from the Moonth, the period the Moon takes to orbit Earth about 29.53 days which is known as the Synodic Month.

Astronomically speaking the Moon appears large in the sky with an apparent diameter of about ½ degree. By pure coincidence this is virtually the same apparent diameter as the Sun as seen from Earth. For this reason we are able to enjoy the spectacle of the total eclipse. Due to the slightly elliptical orbit of the Moon around Earth and Earth around the Sun, the apparent sizes do vary causing a difference in the comparative sizes and different degrees of eclipse.

Sometimes the Moon appears too small to completely cover the Sun and an 'annular' eclipse is seen. When the Moon appears significantly larger than the Sun, a longer lasting eclipse occurs. As the Moon moves further away it will eventually appear to be smaller than the Sun there will be no more total eclipses only annular and partial eclipses.

Visually the Moon is the second brightest object in the sky only exceeded by the Sun. From our vantage point, on Earth, we see the Moon illuminated by the Sun at different angles as the Moon moves around its orbit. These changes are known as the Moon phases. When the Moon is positioned between the Sun and us, the far side is illuminated and the side facing us is dark so we can't see it. (the far view in the diagram below)



As the Moon moves around us the bright side gradually appears and we are presented with a 'New Moon'. When the Moon has moved half way around the Earth we see half the Moon illuminated. At the point where the Moon is on the opposite of Earth to the Sun the whole of the Moon facing Earth is illuminated giving us a 'Full Moon'. (lower view)

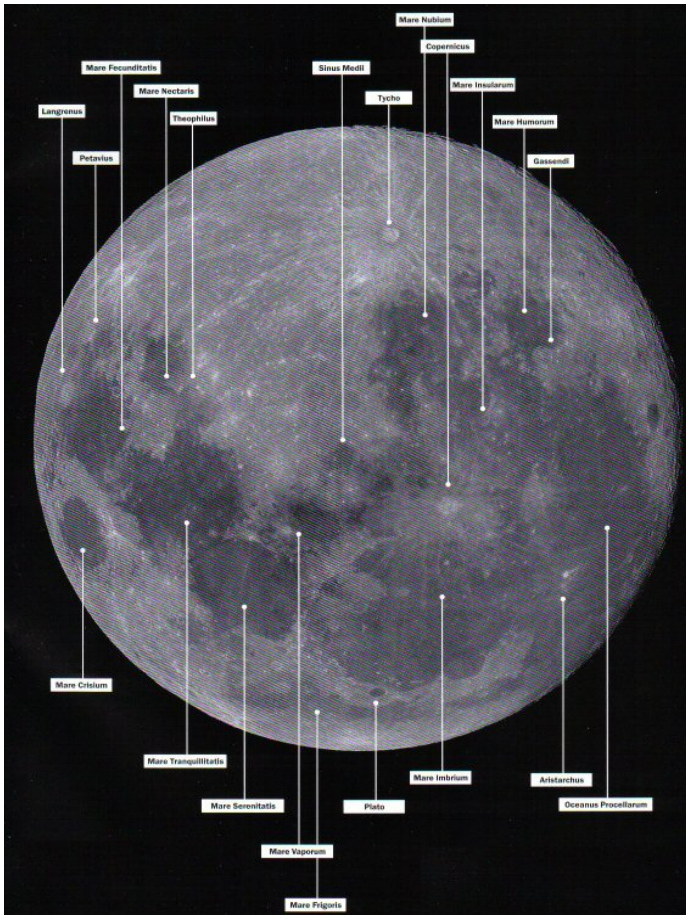
With naked eye we can make out dark markings on the surface of the Moon, especially during full Moon. These dark markings are known as seas or mare. They are not seas at all, just areas of darker material.

Through binoculars or a small telescope the surface of the Moon is seen to be covered with craters. At one time there was much dispute over whether these craters were volcanic in origin or caused by impacts. It is now almost universally accepted that the vast majority are meteor craters caused early after the formation of the solar system 4 billion years ago. While the interior was still hot, molten rock flowed out and filled the largest craters and the seas were created. All this activity died out over 3 billion years ago so nothing much happens today.

OBSERVING THE MOON

For a beginner to astronomy, the Moon is an excellent place to start. It is large, bright, easy to find and covered with interesting things to see. It may still be necessary to locate the Moon using the finder but a seasoned observer may be able to find it straight away without using the finder. The full Moon is very impressive to the naked eye but is probably least rewarding viewed through a telescope. At full Moon the Sun is shining straight down on the surface and casts very little shadow. The best time to see specific features is as the terminator (the line between light and dark) passes over those features and the Sun casts long shadows. The full Moon is so bright that it may be uncomfortable to the eye. Filters can be bought and attached to the eyepiece to reduce the brilliance and improve contrast. A cheaper option is to make a cardboard mask to cover the end of the telescope tube. Into this mask a hole of about 50mm can the cut to reduce the amount of light entering the telescope.

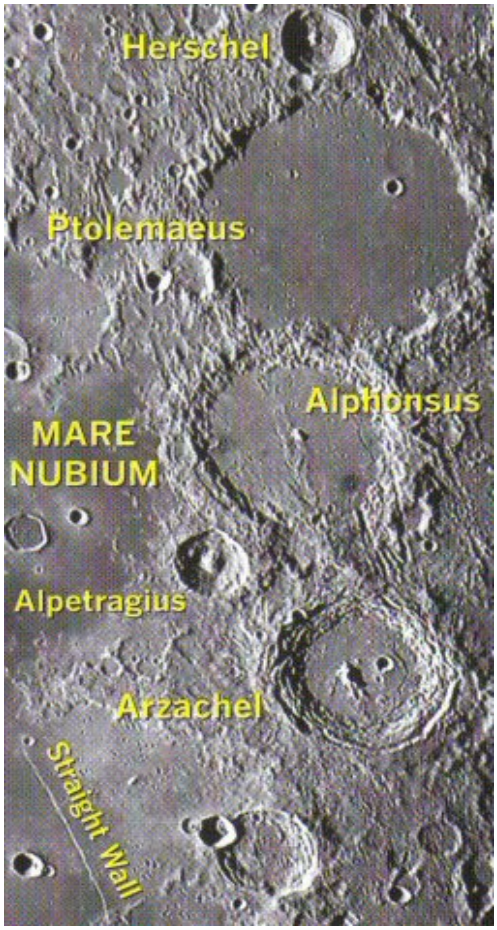
Depending on the conditions, high magnifications can be used. First centralise the object or region of the Moon to be observed using a low power eyepiece then carefully replace the eyepiece with a higher magnification eyepiece (shorter focal length) and refocus. The object will appear larger and more detail will be seen. As the magnification is increased the size of the hole in the mask may need to be increased or the mask removed to allow more light into the telescope to improve the contrast.



Maria or seas are not seas at all, they are large areas that have been covered by molten rock in the distant past but later than the main crater forming era. To the naked eye the Maria appear as darker patches but through a telescope they are seen as relatively smooth plains with a sprinkling of small craters. The Moon does not rotate, as seen from the surface of Earth and keeps the same face towards us. A terminator will therefore cross over a feature twice every month.

Craters are especially spectacular on the terminator because sunlight will illuminate the outside of one wall and the inside of the wall on the other side of the crater, with the opposite side of the wall in shadow. Some craters have a central peak and may have terraced walls. Other craters have radial lines called rays stretching for many hundreds of kilometres where debris was thrown out by the impact of the object that created the crater. Other interesting things to look for are craters inside larger craters and impacts that have created craters on top of earlier craters there are double and even treble crater systems.

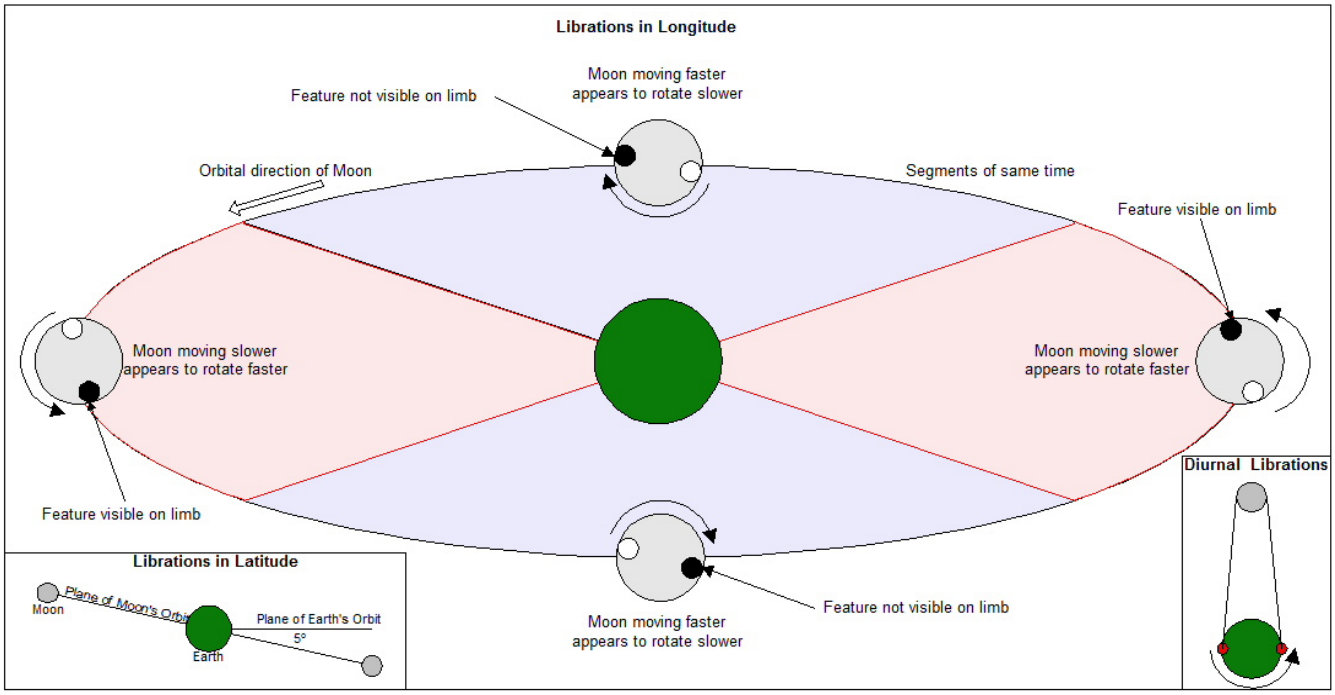
Some of the larger craters may have terraced walls both inside and outside the main rim. There may even be smaller craters on the floor of the large crater or another crater may cut through the wall of a large crater.



These craters are located in the centre of the Moon

Some areas of the Moon are more cratered than others. There are large areas that have so many craters that there appear to be no smooth areas at all. Other areas have almost no craters. There are some craters that appear to have been filled with lava and have smooth dark floors.

There are also mountain ranges that are often named after mountain ranges on Earth. Many of these mountain ranges appear to be the walls of vast craters that have all but disappeared due to the erosion caused by the deluge of later meteor impacts. There are however some natural mountain ranges. In the bottom left corner of the picture above there is a feature called The Straight Wall. This is a common type of feature known as ‘Rill’ and appears to be a vast crack in the ground, the exact cause of most of these features is still uncertain.



The Moon has a captured rotation, this means that it rotates at the same rate is it orbits the Earth, once every 29½ days. The Moon's rotation is in relation to the rest of space but not to us on Earth therefore it appears to keep the same face towards Earth all the time.

By saying the Moon keeps the same face towards Earth it could be assumed that we can only see 50% of the surface of the Moon. However this is not case due to a phenomenon called LIBRATIONS. There are three processes that enable the effect of librations to allow about 59% of the Moon to be observed from the surface of Earth. The three kinds of librations are: (1) librations in longitude, (2) diurnal (daily) librations and (3) librations in latitude. See the diagram above.

Librations in Longitude The orbit of the Moon is slightly elliptical therefore it is closer to Earth at the two positions of the minor axis and further away at the positions of the major axis. At its closest approach, the Moon travels faster (as determined by Keplar's Laws of motion). The rotation of the Moon on its axis remains constant so its rotation speed compared to its velocity is reduced and its rotation appears to slow down. The opposite effect occurs when the Moon is furthest away. The overall effect is that the Moon appears to rock from side to side slightly and we can see slightly further around the edges.

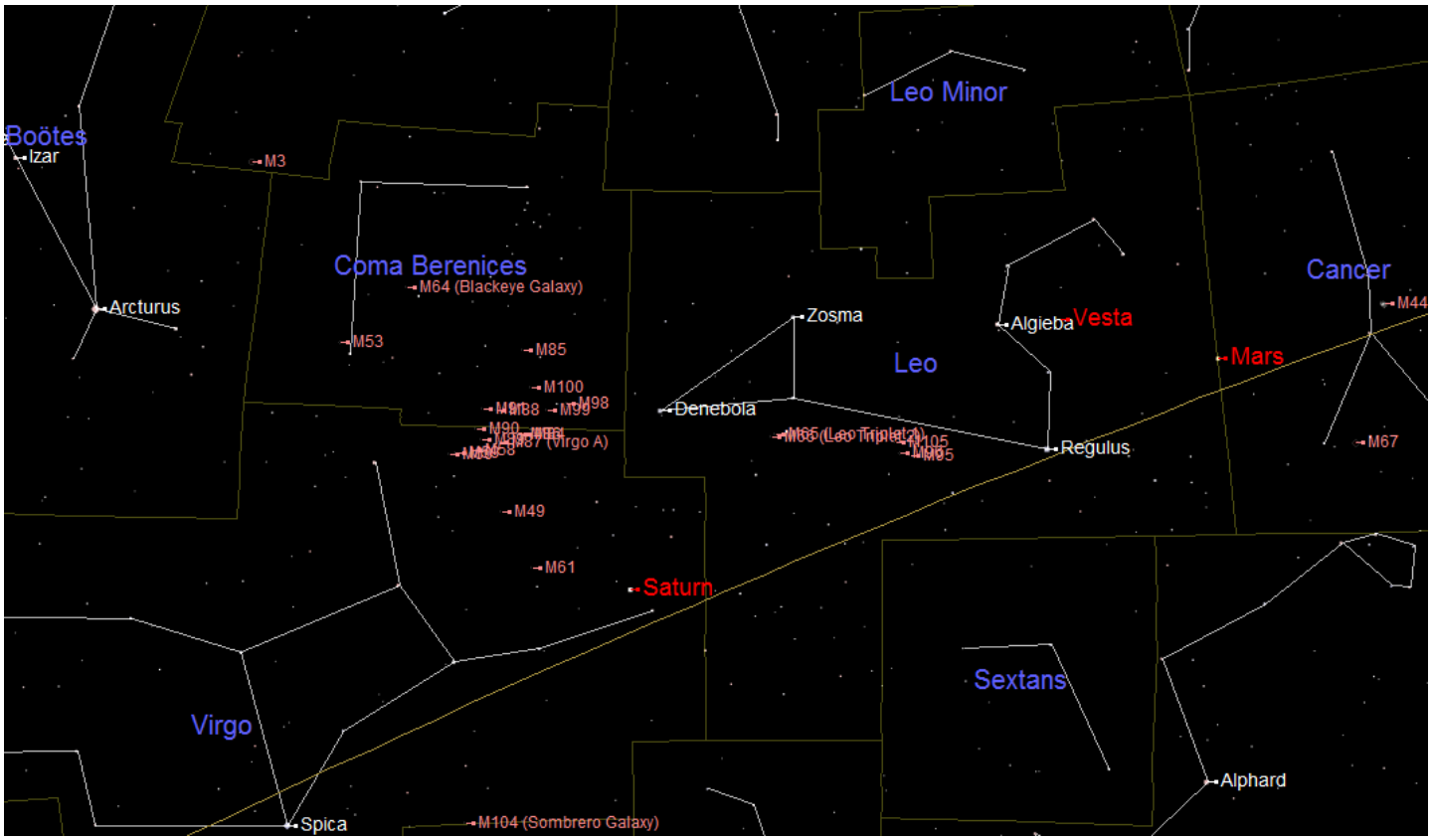
Diurnal (daily) Librations In the morning we can view the Moon from one side of Earth but by the evening Earth has rotated through 180° on it axis. Therefore the observers will have moved their viewing position 12,700 km (the diameter of Earth). This is like looking at a shed at the end of a garden from a certain position where one side of the shed can just be seen but the other side cannot be seen. By taking a step or two to the side, the other side of the shed can be seen but the first side cannot now be seen. This effect also allows us to look slightly further round each side of the Moon.

Librations in Latitude This effect is due to the orbital path of the Moon around Earth being tilted by about 5° to the plane of the solar system. As a result the Moon appears to move up and down slightly as it moves around Earth. When the Moon is at its lowest point in its orbit we can see further over the north pole. When the Moon is at its highest point in its orbit we can see further over the south pole.

Even with the help of librations we can never see the other 41% of far side of the Moon from Earth. It wasn't until the Russian space craft Lunik III was sent around the Moon in October 1959, that mankind could see what the back of the Moon looked like. The most noticeable difference was that there are very few Maria on the far side compared to the near side. The image below shows part of the nearside on the right and the far side on the left. The rim of the giant Orientale Basin crater (in the centre of the image) can just be glimpsed from Earth thanks to librations in longitude.

Part of the far side imaged by the Galileo space craft

We tend to think of the Moon as a boring place where nothing happens. This may not be the case. Some modern astronomers have reported seeing misty patches in craters that sometimes have a reddish colour. These have even been confirmed by spectrographic images. It is thought they may be plumes of gas being released from a pocket below the surface. There have also been reports in the past of possible meteor impacts but these have not occurred in modern times. There is always the hope of being the first to see one.



The positions of Saturn and Mars in the south at 21:00 on 15th March 2010

MERCURY is not visible from the UK this month.

VENUS can be seen in the west as the Sun sets at 20:45 with Venus following the Sun over the horizon at 22:07. Venus is very bright and is very obvious low in the west. The planet has climbed out from behind the Sun and will move up in the sky in an arc over the next few months. At the moment it is on the opposite side of the Sun to Earth and therefore appears almost fully illuminated and circular. As Venus moves around it orbit and appears to loop up and away from the Sun it will also be moving closer to us and will increase in size. By the beginning of August it will be at a right angle to the Sun with the half facing the Sun illuminated. It will appear larger and like a miniature half Moon.

MARS rises in the east at 11:20 mid month and will be high in the south at 19:00 (in daylight). It is just moving out of the constellation of Cancer and into Leo. See the chart above. It appears small but will be in a good position for observing for most of the night. A large telescope and a clear calm night will be required to see its small 6½ arc second rusty coloured disc. Even a larger telescope will struggle to show even the more distinctive surface markings and the white polar ice cap.

JUPITER is just moving out from behind the Sun into the pre sunrise sky in the east. It is observable to the early riser but is close to the horizon. See the special article on Page 1.

SATURN rises in the east at 17:00 and will be high enough for viewing by dusk. It is well placed in the constellation of Virgo, see the chart above. The ring system is just starting to open out again after appearing edge-on for most of last year. It is just possible to see the Cassini Division (the gap in the ring system) and up to four moons but this does require a larger telescope.

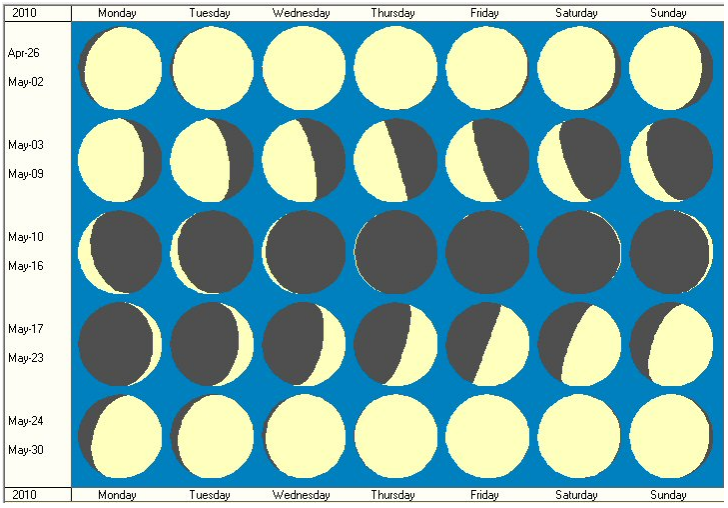
URANUS is close to Jupiter in the eastern early morning sky.

NEPTUNE has now has moved out from behind the Sun and will be observable in the east two hours before sunrise.

THE SUN There has been a few Sunspots appearing over the last few months but they have been small and short lived. The Sun has an eleven year cycle of increasing sunspot activity. We should now be well into a period of maximum activity but the activity has been very sparse until the last few months with just a few spots starting to appear.

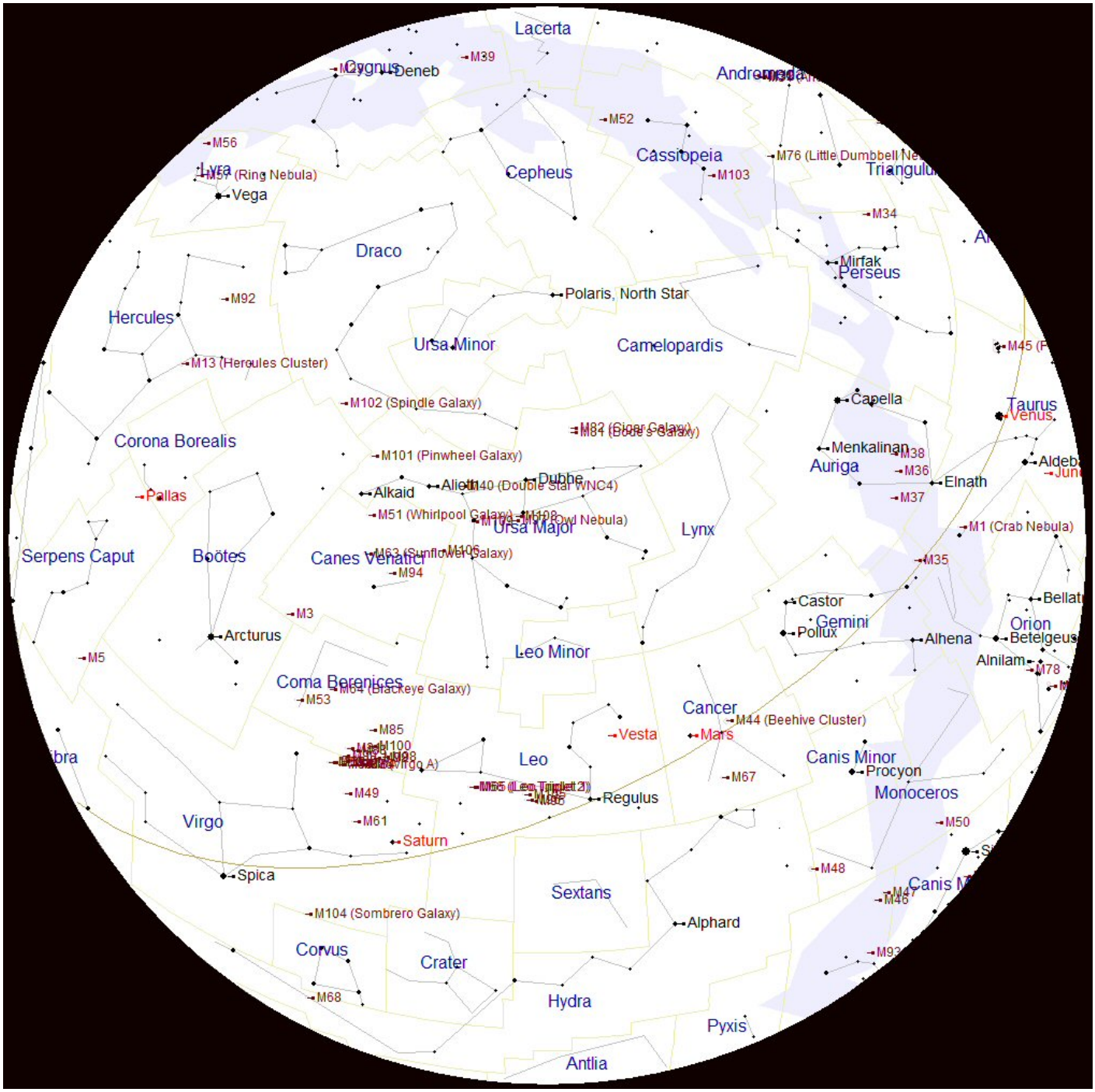
A special solar filter must be fitted to a telescope to view sunspots or alternatively the image can be projected on to a screen. **DO NOT LOOK DIRECTLY AT THE SUN AS IT WILL CAUSE BLINDNESS**.

THE MOON The phases of the Moon this month:



Objects on the 'Terminator' (the line between light and dark) are in the best position to observe features because they cast long shadows that give relief to the features. See the articles on Pages 2, 3 and 4.

THE SKY THIS MONTH



The chart above shows the night sky as it appears on 1st May at 10 o'clock British Summer Time (GMT). As the Earth orbits the Sun and we look out into space each night the stars will appear to have moved across the sky by a small amount. Every month Earth moves one twelfth of its circuit around the Sun, this amounts to 30 degrees each month. There are about 30 days in each month so each night the stars appear to move about 1 degree. The sky will therefore appear the same as shown on the chart above at 9 o'clock BST at the middle of the month and at 8 o'clock GMT at the end of the month. Due to the Earth rotating once every 24 hours, the stars also appear to move 15º (360º divided by 24) each hour from east to west.

The centre of the chart will be the position in the sky directly overhead. First we need to find some familiar objects so we can get our bearings. The Pole Star **Polaris** can be easily found by first finding the familiar shape of the Great Bear 'Ursa Major' that is also sometimes called the Plough or even the Big Dipper by the Americans. Ursa Major is visible throughout the year from Britain and is always quite easy to find. This month it is directly overhead. Look for the distinctive saucepan shape, four stars forming the bowl and three stars forming the handle. Follow an imaginary line, up from the two stars in the bowl furthest from the handle. These will point the way to Polaris which will be to the north of overhead at about 50º above the northern horizon. Polaris is the only moderately bright star in a fairly empty patch of sky. When you have found Polaris turn completely around and you will be facing south. To use this chart, position yourself looking south and hold the chart above your eyes.